I claim:

1. A quantum computing structure comprising:

a first bank of a superconducting material having a first crystal orientation;

an island of a superconducting material having a second crystal orientation, wherein at least one of the island and the bank comprises a d-wave superconducting material; and

a clean Josephson junction between the island and the bank.

2. The structure of claim 1, further comprising a single electron transistor connected between the island and ground.

3. The structure of claim 1, wherein the Josephson junction comprises a grain boundary between the bank and the island.

4. The structure of claim 1, wherein the island comprises a d-wave superconducting material.

5. The structure of claim 4, wherein the bank comprises a d-wave superconducting material.

6. The structure of claim 1, further comprising:

a second bank of superconducting material having a third crystal orientation; and

a Josephson junction between the first and second banks.

7. The structure of claim 6, further comprising a single electron transistor coupled between the second bank and the island.

8. A quantum register comprising:

a bank of a superconducting material;

a plurality of islands of superconducting material; and

a plurality of clean Josephson junctions, each clean Josephson junction being between the bank and a corresponding one of the islands.

9. The quantum register of claim 8, wherein each of the island comprises a d-wave superconductor.

10. The quantum register of claim 9, wherein the bank comprises a d-wave superconductor.

11. The quantum register of claim 8, further comprising a plurality of single electron transistors, each single electron transistor being between ground and a corresponding one of the islands.

12. The quantum register of claim 8, further comprising a first plurality of single electron transistors, each single electron transistor in the first plurality being between islands in a corresponding pair of the islands.

13. The quantum register of claim 12, further comprising a second plurality of single electron transistors, each single electron transistor in the second plurality being between ground and a corresponding one of the plurality of islands.

14. The quantum register of claim 8, further comprising:

a second bank of superconducting material; and

a Josephson junction between the first and second banks.

15. The quantum register of claim 14, further comprising a first plurality of single electron transistors, each single electron transistor being coupled between the second bank and a corresponding one of the islands.

16. The quantum register of claim 15, further comprising a second plurality of single electron transistors, each single electron transistor in the second plurality being between ground and a corresponding one of the islands.

17. The quantum register of claim 15, further comprising a second plurality of single electron transistors, each single electron transistor in the second plurality being between islands in a corresponding pair of the islands.

18. The quantum register of claim 17, further comprising a third plurality of single electron transistors, each single electron transistor in the third plurality being between ground and a corresponding one of the plurality of islands.

19. A quantum computing method comprising:

cooling a structure including a bank and an island to a temperature that makes the bank and the island superconducting and suppresses thermal excitations sufficiently to maintain coherence for a calculation, the structure including a junction that is a clean Josephson junction between the island and the bank;

establishing a quantum state of a supercurrent at the junction, wherein the quantum state is an admixture of a first state having a first magnetic moment and a second state having a second magnetic moment;

allowing the quantum state to evolve according to probabilities for tunneling between the first and second state; and

measuring magnetic flux at the junction to determine a result.

20. The method of claim 19, wherein the supercurrent at the junction is a ground-state current arising from a d-wave superconductor in the structure.

21. The method of claim 19, wherein measuring magnetic flux comprises:

grounding the island to fix the supercurrent in the first or second state; and

measuring the magnetic flux while the island is grounded.

22. The method of claim 19, wherein establishing the quantum state comprises running a current through the bank.

23. The method of claim 19, wherein the structure further comprises a plurality of islands and a plurality of junctions, each junction being a clean Josephson junction between the bank and a corresponding island.

24. The method of claim 23, further comprising establishing a quantum state of a supercurrent at each of the junctions in the structure, wherein each of the quantum state is an admixture of a first state having a first magnetic moment at the corresponding junctions and a second state having a second magnetic moment at the corresponding junctions.

25. The method of claim 23, wherein allowing the quantum state to evolve comprises controlling conductivities of transistors that coupled islands together, to create entanglements of the quantum states of the islands..

26. The method of claim 23, wherein establishing the quantum states comprises running a current through the bank.

27. The method of claim 26, selecting for each island, a crystal orientation according to the quantum state desired for the island.